DOCUMENT RESUME

ED 380 696 CE 068 690

AUTHOR Cole, Lee Thomas
TITLE Mining Sector. Basic Skills Needs Assessment. INCO (Manitoba Division) & Local 6166 United Steelworkers of America.
INSTITUTION Manitoba Dept. of Education and Training, Winnipeg. Literacy and Continuing Education Branch.
SPONS AGENCY National Literacy Secretariat, Ottawa (Ontario).
PUB DATE 94
NOTE 39p.; Developed for the Workplace Education Manitoba Steering Committee. For related documents, see CE 068 682-689.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adult Basic Education; *Basic Skills; Communication Skills; *Difficulty Level; Educational Research; Foreign Countries; *Literacy Education; Mathematics Skills; *Mining; Needs Assessment; Productive Thinking; *Readability; Reading Skills; *Skill Analysis; Task Analysis; Vocational Education
IDENTIFIERS Manitoba; *Workplace Literacy

ABSTRACT

A project examined the skills gap within the mining industry, identified and prioritized skills common to all jobs and occupations, and provided insight into skills that workers are likely to need in the future. The research for the basic skills needs assessment was conducted from June-October 1993 at INCO's Manitoba Division Operations in Thompson, Manitoba. The following techniques were used: basic skills survey, basic skills task analysis, basic skills assessment, and workplace reading materials assessment. The survey examined the reading, mathematics, communications, and productive thinking skills of 317 employees. Data were analyzed to determine the critical, essential, and important workplace literacy skills based on the percentage and frequency of use. The majority of reading materials were beyond the reading comprehension levels of the majority of participants. Employees were interested in and willing to improve their basic skill levels. Increased demands on employees' basic workplace skills had the most impact on those who moved from one work area to another and who had recently gained supervisory positions. The largest barrier to worker participation in upgrading programs was the shift work inherent in the industry. General recommendations were as follows: a distinction between teaching of basic skills and task-specific training; inclusion of shift workers as a priority; and inclusion of English as a second language. (Appendixes include the survey instrument and list of 11 references.) (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 380 696

WORKPLACE EDUCATION MANITOBA

MINING SECTOR

BASIC SKILLS NEEDS ASSESSMENT

INCO [MANITOBA DIVISION]
&
LOCAL 6166 UNITED STEELWORKERS OF AMERICA

Workplace Education Manitoba
KEEPING PACE WITH CHANGE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
S Howell
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

by Lee Thomas Cole
Educational Technology Consultant, 1994

CE 068 650

BEST COPY AVAILABLE

ACKNOWLEDGMENTS

Members of the Workplace Education Manitoba Steering Committee [WEM]: Rob Despins, Greg Maruca, Pat Moore, Sylvia Magyar, and Sue Turner, would like to thank the National Literacy Secretariat of Human Resources Department Canada for their financial assistance. In particular, we would like to thank Bridgit Hayes, Program Consultant with the National Literacy Secretariat. The Workplace Education Manitoba Steering Committee would also like to thank the Manitoba Government for providing coordination for this project through the Manitoba Literacy and Continuing Education Branch of the Manitoba Department of Education and Training.

The author would like to thank the Educational Process Improvement Team of INCO's Manitoba Division: Morgan Svendsen, Marty Sanders, Ron Tate, Merralyn Kidd, Ed Chuckrey, Dan McSweeney, and Anne Nicholls, for their support and assistance during the data gathering portion of the project. Appreciation is also extended to the members of the Thompson workforce who volunteered their time and expertise and who made the study possible. Thanks are due also to Janine Gagnon and Nicole Gagnon who helped tally the data, and to Caroline Ben-Ari who edited the final drafts of the report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

INTRODUCTION 3

THE PROCESS 3

PROJECT PARTICIPANTS 4

BASIC SKILLS SURVEY 5

READING SKILLS 6

MATHEMATICS SKILLS 8

COMMUNICATION SKILLS 11

PRODUCTIVE THINKING SKILLS 13

BACKGROUND AND EDUCATION 17

BASIC SKILLS ASSESSMENT 18

WORKPLACE MATERIALS READABILITY ASSESSMENT 20

GENERAL READING MATERIALS ASSESSMENT RESULTS 21

WORK AREA READING MATERIALS ASSESSMENT RESULTS 22

CONCLUSIONS 25

RECOMMENDATIONS 27

APPENDIX 30

EXECUTIVE SUMMARY

The Problem

Where once much of the mining industry's basic skill requirements focused on strength and stamina, today's workplace increasingly requires workers to use reading, writing, mathematics, and thinking skills. In addition, the workforce requires a strong grasp of computer skills, productive thinking skills and problem-solving skills, among others. The purpose of this project was to examine the skill gaps within the industry, to identify and prioritize the skills common to all jobs and occupations within the industry, and to provide insight into the skills that workers are likely to need in the near future.

The Process

The research for the Basic Skills Needs Assessment was conducted from June 1, 1993 to October 28, 1993 at INCO's Manitoba Division Operations in Thompson, Manitoba. The Basic Skills Needs Assessment consists of four parts: Basic Skills Survey, Basic Skills Task Analysis, Basis Skills Assessment, and Workplace Reading Materials Assessment.

Basic Skills Survey: This portion of the study consisted of confidential interviews with 317 randomly selected participants. The interview questionnaire contained questions on the basic job-site skills the participants perceived themselves as using to undertake the duties required by their jobs, as well as on their background and education.

Basic Skills Task Analysis: This portion of the study consisted of confidential interviews with eight middle-skill level workers, one from each work area. The tasks outlined in the participant's job description were examined for the basic job-site skills used to complete each task.

Basic Skills Assessment: Every participant in the Basic Skills Survey was given the option of completing the Basic Skills Assessment, which examined participants' current skill levels in four areas: reading, mathematics, writing and self-expression.

Workplace Reading Materials Assessment: Representative reading materials were collected from throughout the INCO operations. The samples were analyzed for readability levels using eight different computer indexes.

EXECUTIVE SUMMARY [cont.]

Conclusions

- The majority of reading materials examined are beyond the reading comprehension levels of the majority of participants when compared to the results of the basic skills assessment.
- Government documents and employment documents are overly complicated in language, structure and presentation format.
- There is a strong interest and willingness on the part of employees to improve their Basic Skill Levels.
- The increased demands on employees' basic workplace skills impact most on those employees who are moving from work area to work area, and on workers who have recently gained supervisory positions.
- Current training department courses and personnel are not geared to identify, evaluate or provide instruction in the areas of basic workplace skills development.
- Current employee induction and orientation procedures tend to mask or ignore problems which could arise on the work site due to a lack of basic workplace skills.
- The largest barrier to worker participation in upgrading programs is the schedule created by the shift work inherent in the industry. This was indicated by comments volunteered by several participants during their interviews.

General Recommendations

- That a distinction be made between the teaching of basic skills and the task-specific training current in the industry.
- That the inclusion and success of shift workers be a priority in the development and delivery of all programs.
- That the inclusion of an English as a Second Language component be a priority in program development.

The body of the report contains specific recommendations for curriculum development, program delivery, and course development.

INTRODUCTION

Definition of Basic Skills

Where once much of the mining industry's basic skill requirements focused on strength and stamina, today's workplace increasingly requires workers to use reading, writing, mathematics, and thinking skills in order to perform their job tasks. Furthermore, the workplace is evolving into a technical one that, in addition, requires the workforce to possess a strong grasp of computer skills, productive thinking skills, information processing skills, judgment and decision-making skills, critical and creative thinking skills, interpersonal and social skills, and problem-solving skills. Both workers and management are aware of the need to develop these basic skills in those who lack them and of the need to upgrade the skills of those who possess them.

Purpose

The purpose of this project was to examine the skill gaps within the industry, to identify and prioritize the skills common to all jobs and occupations within the industry, and to provide insight into the skills that workers are likely to need in the near future. The major focuses of the project were to assemble a database of skills to provide a statistical reference base for future curriculum and course development, and to develop recommendations to the industry for program development.

THE PROCESS

The research for the Manitoba Mining Sector Basic Skills Needs Assessment Project was conducted from June 1, 1993 to October 28, 1993 at INCO's Manitoba Division Operations in Thompson, Manitoba. The INCO operations consist of three underground mines, an open pit mine, a crushing mill, a smelter, a refinery, maintenance shops, administration offices, technical support services and professional staff and services.

The Basic Skills Needs Assessment consists of four parts: Basic Skills Survey, Basic Skills Task Analysis, Basis Skills Assessment, and Workplace Reading Materials Assessment.

THE PROCESS [cont.]

Basic Skills Survey: This portion of the study consisted of confidential interviews with 317 randomly selected participants, representing the following eight work areas: Mines (underground), Mill, Smelter, Refinery, Maintenance, Administration, Technical, and Professional employees. The interview questionnaire contained 346 questions on the basic job-site skills the participants perceived themselves as using to undertake the duties required by their jobs, as well as on their background and education.

Basic Skills Task Analysis: This portion of the study consisted of confidential interviews with eight middle-skill level workers, one from each work area. The tasks outlined in the participant's job description were examined for the basic job-site skills used to complete each task. The same questions that were used in the Basic Job-Site Skills section of the Basic Skills Survey were used to examine each task. The results of the Basic Skills Task Analysis are presented in a separate report.

Basic Skills Assessment: Every participant in the Basic Skills Survey was given the option of completing the Basic Skills Assessment, which examined participants' current skill levels in four areas: reading, mathematics, writing and self-expression. Completion of the assessment form was voluntary, therefore the results represent only the responses of those who participated and do not necessarily indicate the skill levels of the entire workforce. The detailed method and results of the Basic Skills Assessment are presented in a separate report. However, the main points are presented in this report.

Workplace Reading Materials Assessment: Representative reading materials were collected from throughout the INCO operations, and included materials common to all work areas as well as materials specific to particular work areas. The samples were analyzed for readability levels using eight different computer indexes.

PROJECT PARTICIPANTS

The 317 participants in this project were randomly selected from the INCO Manitoba Division employee listings and represent a cross-section of abilities and personalities from across the workforce. Each person answered 346 questions requiring 587 responses as part of the Basic Skills Survey, which produced 186,075 units of data.

Number of participants by work area:

Hourly Workforce					Salaried Workforce			Total
Mines	Mill	Smelter	Refinery	Maintenance	Admin.	Technical	Professional	Workforce
76	5	28	36	81	9	51	31	317

BASIC SKILLS SURVEY

Data Collection

The Basic Skills Survey interview questionnaire (see Appendix 1) examined skills in four areas: reading, mathematics, communications and productive thinking skills. Each skill area was further broken down in to sub-sections [e.g., *reading skills* was subdivided into job site reading skills and company and union materials]. Responses were recorded as positive if the item was a factor in the completion of the participants job, and as negative if the item was not a factor in job performance. If the response was positive, the frequency of use was recorded as daily, weekly, monthly or half- yearly.

Critical Workplace Skills

A skill was deemed critical if the positive response rate was $\geq$ 90% and the combined percentage usage on a daily or weekly basis was $\geq$ 80%.

Essential Workplace Skills

A skill was deemed essential if the positive response rate was > 75% and the combined percentage usage was > 65%.

Important Workplace Skills

A skill was deemed important if the positive response rate was $\geq$ 60% and the combined percentage usage was $\geq$ 50%.

The results are presented by total workforce, hourly workforce, and salaried workforce, as well as by individual work area, for each of the four skill areas.

The questionnaire also contained questions about the background and education of the participants. The significant points are presented after the skills survey results.

READING SKILLS

Reading skills were subdivided into Job Site Reading Skills and Company/Union Materials

Job Site Reading Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Drawings / Sketches	I_2	I_4	E_3	I_1							C_7
Permits			I_1								
Production / Work Schedules			E_5		C_1						E_1
Specifications	I_3	I_3	E_4		E_1			C_3		E_2	
Computer Screen			C_4		E_2				C_1	C_4	C_6
Computer Printouts			C_3						C_2	C_3	C_1
Charts, Tables or Graphs	I_4		C_6		I_1					C_7	C_4
Check Lists	E_1	I_1	C_5	I_3	C_2		I_1	E_2	E_1	C_6	C_5
Memos or Notes	E_2	I_2	C_1		E_3			E_1	C_3	C_2	C_2
Operating Instructions	I_1	I_3			E_5						
Time / Log Sheets	I_5		E_1		E_4	E_1				C_8	C_8
Tool or Equipment Instructions											
Manuals											
Company Rules / Regulations					C_4						
Hazard Labels / WHMIS / MSDS							I_2				
Safety Regulations				I_2							
Safety Signs / Posters	C_1	C_1		C_1	C_3	C_1	E_2	C_2	E_2	C_3	
Symbols	C_2	C_2	C_2	C_2	E_6	C_2	E_1	C_1	C_4	C_1	C_3
Technical Journals											
Process Improvement Team Minutes					I_3					E_3	
Technical Literature			E_2		I_4					E_1	
Assay Sheets					I_2						I_1
Incident / Inspection Reports					C_5						

READING SKILLS [cont.]

Company/Union Material Reading Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Collective Agreement											
Safety and Health Minutes											
Pension Information											
Constitution and Bylaws [Union]											
Training Material											
Mines Act											
Workplace Safety and Health Act											
Shareholders Report											
Benefax Statement											
Budgets / Costs											
Monthly Reports from Other Areas											
Background on Other Areas											
Annual Report											
OEMP Report and Information											
Steel Gauntlet											
Extra	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1
Clipper											

MATHEMATICS SKILLS

Mathematics skills were subdivided into Basic Mathematics Skills, Technical Mathematics Skills, Measurement Skills, and Tool Skills.

Basic Mathematics Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Add or Subtract Numbers	E_3	E_3	C_1	E_1	C_1	I_1	E_3	C_2	C_1	C_1	C_1
Add or Subtract Fractions			E_2							E_2	C_9
Add or Subtract Decimals	I_1		C_3					C_3	I_1	C_3	C_2
Multiply or Divide Numbers	E_4	I_1	C_2	I_1	I_1			C_3	E_1	C_2	C_3
Multiply or Divide Fractions			E_3							E_1	C_{10}
Multiply or Divide Decimals	I_2		C_7						I_2	C_6	C_4
Convert Fractions and Decimals			E_1					E_1		C_8	C_8
Count How Many	C_1	C_1	C_3	C_1	E_1	E_1	C_1	C_1	C_2	C_3	C_5
Estimate Time	E_1	E_2	C_4	C_3	C_2	E_2	E_1	C_6	E_2	C_4	C_6
Estimate Materials	E_2	E_1	C_6	C_2	C_3	E_3	E_2	C_4	E_3	C_7	C_7

MATHEMATICS SKILLS [cont.]

Technical Mathematics Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Percentage			C_3							C_3	C_2
Ratios or Proportions			E_2		I_1						C_4
Data			C_1		I_2			I_3	I_1	C_1	C_1
Graphs, Charts, Tables			C_2					I_2		C_2	C_3
Statistics											
Probabilities			I_3							I_2	
Trigonometric Functions											I_2
Right Triangle Relationships											I_3
Applied Linear Equations											
Applied Non-Linear Equations											
Powers and Roots			I_7								E_3
Scientific Notation											I_1
Signed Numbers and Vectors											I_4
Scale Drawings			I_2							I_3	
Lines and Angles			I_4					I_4			
Two- and Three-Dimensional Shapes			I_5							I_5	E_1
Estimating Solutions			E_3					I_1		E_2	C_7
Problem Solving			E_1					C_1	E_1	E_1	C_5
Specifications			I_1					C_2		I_1	C_6
Calculate Weightometer Readings (%)											
Concentration Data (ppm, gpl, etc.)			I_6							I_4	E_2

MATHEMATICS SKILLS [cont.]

Measurement Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Measure in Imperial	E_1	E_1	E_1	I_1	E_1	I_2		C_1		E_3	C_1
Measure in Metric	I_3		E_2		I_1			E_2		C_1	E_4
Convert Imperial and Metric Measures			I_3							I_2	
Measure Volume			I_2							I_1	E_2
Precision, Accuracy, Tolerance	I_1	I_2	E_4			I_3		E_1		I_6	C_2
Temperature	I_6		I_6			I_1		E_4		I_3	I_1
Pressure	I_2	I_1	I_4					E_3		I_4	E_3
Volume	I_4		E_3		E_2			I_2		E_2	C_3
Flow	I_5		I_5		I_2			I_1		I_5	E_5
Mass / Weight			I_1		E_3			I_4		E_1	E_1
Acceleration											
Density			I_7							I_7	I_2
pH											
Measure Current / Voltage								I_3			I_3
Millivolts											

Tool Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Hand Tools	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1	C_2
Tape Measure	E_2	E_3	E_1	E_1		I_3		C_2		C_4	C_4
Scales on Equipment	I_2	I_1	E_2		E_1			E_1		E_1	E_1
Gauges or Dials on Equipment	E_1	E_1	E_3	C_2	E_2	I_1	I_2	C_3		E_2	E_2
Mobile Equipment	I_1	E_2		C_3	C_2	I_2	I_1	E_2			
Calculator			C_2					E_3		C_3	C_1
Computer			C_3		I_1				C_2	C_2	C_3
Advanced Instruments / Instrumentation			I_1							I_1	I_1

COMMUNICATION SKILLS

Communication skills were subdivided into Writing Skills, Oral Skills, and Communication Tool Use Skills.

Writing Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Fill in Forms	E_1	E_2	C_1	C_1	C_1	I_1	I_1	E_1	C_1	C_2	C_2
Fill in Time Cards	I_2	I_1			C_2	C_1	C_1	C_1			
Keep Track of Hours	E_2	E_1	E_3	I_1	I_1	C_2	C_2	C_2	E_1	E_2	E_1
Write Shift Reports					E_1	I_2					
Leave Notes / Memos	I_1	I_2	C_2	I_2	E_2			E_2	E_2	C_1	C_1
Write Work Orders			I_1		C_3						I_1
Write Incident Reports											
Write Instructions			E_1		I_2						
Make Drawings / Sketches	I_3		E_4							E_1	C_3
Write Letters / Reports											
Write Safety Reports											
Input Data on Computer			E_2						C_2	E_3	C_4

Oral Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Follow Verbal Directions	C_1	C_1	C_1	C_1	C_1	C_1	C_2	C_1	C_1	C_4	C_4
Give Verbal Directions	C_3	E_1	C_5	C_3	E_1	E_1	E_1	C_4	C_2	C_3	C_7
Follow Written Directions	E_3	E_4	C_6		C_2		I_2	C_3		C_5	
Give Written Directions			C_7							C_7	
Ask Questions	C_2	C_2	C_2	C_2	C_3	C_2	C_1	C_2	C_3	C_1	C_1
Take Messages	E_1	E_3	C_4	E_1		I_1		E_1			C_2
Speak in Large Groups	I_1										
Speak in Small Groups								I_1			
Speak with Outside People (e.g., suppliers)									E_1		C_6
Participate in Meetings										C_6	C_3
Use the Telephone	E_2	E_2	C_3	C_4	E_2	E_2		E_2	C_4	C_2	C_3

COMMUNICATION SKILLS [cont.]

Communication Tool Use Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Use Typewriter											
Use Fax Machine			I_1							I_2	
Use Photocopier			C_1						C_1	C_1	C_1
Use Hand Signals		E_3		I_1	E_1	C_2		E_1		I_1	
Use Two-Way Radio					I_1						
Use MD ISSUE			I_2						I_1	E_2	
Use Mainframe Computer			E_1						C_2	C_2	
Use Process Control Computer					I_2						
Use Personal Desktop Computer			E_2						C_3	E_1	E_1
Use Portable Computer											
Use Remote Control Radio Equipment					E_2						
Coordinate Work with Other Groups	E_1	E_1		E_2	E_3	C_1	I_1	C_2	E_1		C_2
Work with Trade Groups	E_2	E_2		E_1	E_4	E_1		C_1			E_2

PRODUCTIVE THINKING SKILLS

Productive Thinking skills were subdivided into: Information Processing Skills; Judgment and Decision Making Skills; Problem Solving Skills; Formal Reasoning, Critical Thinking, and Logic Skills; and Creative Thinking Skills.

Information Processing Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Process information in a variety of ways	C_1	C_1	C_1	C_1	E_1	C_1	C_1	C_1	C_1	C_1	C_1
Research information or data	E_8	I_3	C_7	E_6		I_5		C_2	C_2	C_{10}	C_7
Analyze information or data	E_{10}	I_7	C_{12}	I_8		I_1		E_8	E_1	C_{12}	C_8
Design systems			E_2							E_3	C_{18}
Design products			I_1								E_1
Engineer solutions	I_7			I_7						E_2	C_{17}
Perform system analysis [troubleshooting]	E_3	E_2	C_{16}	C_2		C_3	E_1	I_2	E_2		C_{19}
Perform technological assessments	I_3	I_9	E_1	I_1		I_2		I_3	I_1	E_1	C_{15}
Identify inconsistencies, deficiencies, contradictions	E_2	E_3	C_8	E_1		E_5		E_2	C_3	C_{11}	C_{12}
Make inferences	I_1	I_8	C_{13}	E_4		I_6		I_4	E_5	C_8	C_{16}
Identify main ideas	I_2	I_{10}	C_9	I_6		I_4		I_1	C_4	C_7	C_2
Summarize and condense information, facts	I_4	I_{11}	C_{13}	I_2				I_6	E_3	C_{14}	C_3
Note similarities and differences between facts	E_7	I_4	C_2	E_3				E_4	C_5	C_4	C_4
Classify facts	I_6		C_{10}			E_3		I_5	C_8	C_9	C_{11}
Identify stated and unstated reasons	E_9	I_3	C_3	I_3		E_4		E_3	C_7	C_6	C_9
Recognize associations and connect information	E_4	I_1	C_4	E_5		E_1		E_6	C_8	C_3	C_5
Form conclusions and generalizations from facts	E_5	I_2	C_5	I_3		E_2		E_5	C_9	C_2	C_6
Make predictions on the basis of patterns in data	I_5	I_{12}	C_{14}	I_9		I_3		I_7	E_4	C_{15}	C_{14}
Evaluate information according to set criteria	E_9	I_6	C_{11}	I_4		I_7		E_7	C_{10}	C_{13}	C_{13}
Make decisions based on information supplied by others	E_1	E_1	C_6	E_2	I_1	C_2	I_1	E_1	C_{11}	C_5	C_{10}

PRODUCTIVE THINKING SKILLS [cont.]

Judgment and Decision Making Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Identify facts, opinions, and reasoned arguments	E_4	E_4	C_3	C_4		E_3		C_3	E_1	C_1	C_1
Recognize evidence and check it	E_1	E_1	C_1	C_1	I_1	E_2	E_2	C_1	C_1	C_2	C_2
Deal with differing value systems	E_3	E_3	C_2	C_2		I_3		C_2	C_2	C_3	C_3
Distinguish between valid and invalid assumptions	E_2	E_2	C_3	C_3	I_2	E_1	E_1	C_4	C_3	C_5	C_4
Spot inconsistencies and gaps in information	E_3	E_3	C_4	E_1		I_1		C_3	C_4	C_4	C_5
Gather and organize data	E_8	I_3	C_8	E_3		I_4		I_2	C_5	C_8	C_8
Decide whether statements contradict each other	E_6	I_1	C_7	E_2		I_2			C_6	C_7	C_8
Evaluate others' judgments	E_7	I_2	C_8	E_4	I_3	E_4		I_1	C_7	C_8	C_7

Problem Solving Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Solve problems on your own	C_1	C_2	C_1	C_1	E_1	C_2	E_1	E_1	C_1	C_1	C_1
Solve problems as a member of a team	E_8	I_1		E_6	I_1			E_7		C_{10}	
Identify general problems	C_2	C_1	C_2	C_2	E_2	C_3	I_6	C_1	C_2	C_2	C_2
Determine the attributes of a problem	C_4	E_1	C_3	C_3	E_3	C_4	I_1	C_4	C_3	C_3	C_3
Clarify the problem for others	C_3	C_3	C_4	C_3	E_4	C_6	I_2	C_3	C_4	C_3	C_4
Formulate questions about the problem	C_5	E_2	C_5	C_6	E_5	E_1	I_6	C_2	C_5	C_4	C_6
Formulate hypotheses for testing											
Evaluate hypotheses											
Figure out experiments to test hypotheses				I_2							
Integrate information about the problem	E_6	E_6	C_{10}	E_7	I_2	C_1		C_3		C_{11}	C_{12}
Formulate solutions	E_1	E_5	C_6	E_4	E_6	C_5	I_3	E_3	C_6	C_7	C_6
Examine and rank solutions	E_5	E_7	C_{11}	E_5	E_7	E_3	I_9	E_5		C_{12}	C_7
Choose solutions as an individual	E_2	E_4	C_7	E_1	E_6	E_4	I_4	E_2	C_7	C_9	C_5
Choose solutions as a member of a team	I_1	I_2		I_1		I_1		I_2			
Direct others in the application of the solution	E_4	E_6		E_3	I_3		I_{10}	E_6			C_9
Seek acceptance of solutions	E_3	E_3	C_9	E_2	E_9	E_2	I_5	E_4	E_1	C_8	C_{11}
Monitor solutions	E_7	E_9	C_8	C_4	E_{10}	E_3	I_7	I_1		C_6	C_{10}

PRODUCTIVE THINKING SKILLS [cont.]

Formal Reasoning, Critical Thinking, Logic Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Determine the meaning of terms and statements	C_1	C_1	C_7	C_3	E_1	C_1	E_1	C_1	C_1	C_8	C_1
Notice how things differ or are alike	C_3	C_3	C_8	C_1	E_2	E_1	I_1	C_2	C_2	C_9	C_2
Notice successive stages in which things occur	C_2	C_2	C_1	C_2	E_3	C_2	I_2	C_3	C_3	C_6	C_3
Break down wholes into component parts	E_4	E_4	C_9	E_2		I_5		C_5	C_4	C_{12}	C_4
Identify and sort things into classes	E_9	I_3	C_2			I_2	I_3	E_4	C_5	C_2	C_1
Recognize analogies and reason by analogy	E_8	I_2	C_{14}	E_9				E_2	C_6	C_{13}	C_{17}
Represent ideas as three-dimensional images			I_1							I_1	E_2
Judge the credibility of sources	E_7	I_1	C_3	E_6		C_3		I_1	C_7	C_7	C_5
Detect bias, stereotypes	I_1	I_4	C_{17}	E_5		E_3				E_1	C_{12}
Distinguish relevant from irrelevant data	E_6	E_6	C_4	C_6	I_1	E_5	I_7	I_2	C_8	C_3	C_6
Distinguish fact from opinion	E_2	E_2	C_{10}	C_3	I_2	C_4	I_9	E_1	E_3	C_4	C_7
Connect causes and effects	E_1	E_1	C_{11}	C_4	I_3	E_4	I_4	C_4	C_9	C_{10}	C_{13}
Recognize that inductive reasoning is inferring from facts	I_3	I_8	C_{16}	I_1		I_6		E_6	I_1	C_{15}	C_{14}
Use scientific method as a process of validation			E_1							E_7	E_1
Use evidence to examine the validity of beliefs	E_3	E_3	C_{13}	E_1	E_4	E_2	I_{10}	E_3	C_{10}	C_{16}	C_{15}
Examine arguments for ambiguity in the line of reasoning and for contradictory statements	I_2	I_7	C_{15}	E_8		I_4			I_2	C_{14}	C_{16}
Judge whether a definition is adequate, an assumption is correct, and a conclusion is possible, valid or necessary	E_{11}	I_6	C_{12}	E_3	I_4	I_7	I_5		E_1	C_{11}	C_8
Use syllogistic reasoning	E_5	E_5	C_5	E_7	E_5	I_1	I_6	E_5	E_2	C_1	C_9
Analyze and evaluate arguments	E_{10}	I_5	C_6	E_4	I_5	I_3	I_8			C_5	C_{10}

PRODUCTIVE THINKING SKILLS [cont.]

Creative Thinking Skills

Skill Code C_x *critical skills* E_x *essential skills* I_x *important skills* *where the subscript gives the priority of the skill* *(C_1 is used more frequently than C_2, etc.)*	*Total*	*Hourly*	*Salaried*	*Mines*	*Mill*	*Smelter*	*Refinery*	*Maintenance*	*Administration*	*Technical*	*Professional*
Analyze open-ended situations and problems, and restate, reorganize, or break down the problem	E_5	E_7	C_5	E_7	I_1	I_1	I_8	E_5		C_6	C_5
List attributes of objects and situations	E_8	E_{10}	C_8	E_9	I_2	I_3	E_1	E_8	C_1	C_9	C_9
Generate ideas	E_3	E_5	C_1	E_5	I_3	E_3	I_2	E_7	C_2	C_2	C_2
Generate multiple ideas to support multiple viewpoints on the same issue	E_{12}	I_1	C_{12}	I_1		E_2	I_8	E_9	E_1	C_1	C_{12}
Identify and examine alternatives	C_2	E_2	C_2	C_1	I_4	E_1	I_3	C_3	C_3	C_3	C_3
Rank alternatives and choose the best	E_9	E_{13}	C_3	E_3	I_5	E_4	I_4	I_1	C_4	C_4	C_4
Use insight	C_1	E_1	C_6	E_1	I_6	C_1	I_5	C_1	C_5	C_7	C_6
Use intuition	E_1	E_4	C_4	E_2	I_7	C_2		C_2	C_6	C_1	C_7
Identify relationships between situations that may appear unconnected	E_6	E_9	C_9	E_{11}	I_8	E_5	I_7	E_4	C_7	C_8	
Make unusual connections between facts	E_7	E_8	C_{10}	E_{12}	I_9	I_5		C_4			C_1
Tolerate ambiguity, hold conclusion off to search for innovative ideas	E_{10}	E_{12}		E_{13}		I_7		E_6	E_2		C_{13}
Elaborate details	E_{11}	E_{11}	C_{13}	E_{10}		I_6		E_3	E_3	C_1	
Synthesize from various sources to form a new whole	E_{13}	I_2	E_1	E_4		I_2		I_2			C_{14}
Extrapolate from limited facts	E_4	E_6	C_7	E_8	I_{10}	E_6	I_1	E_2		C_5	C_{15}
Use imagery	E_2	E_3	C_{11}	E_6	E_1	C_3	E_2	E_1	C_8	C_1	C_8
Use metacognition	I_1	I_3	E_2	I_2		I_4				E_1	
Use metadata									I_1		

BACKGROUND AND EDUCATION

The significant results from the Background and Education section of the Basic Skills Survey questionnaire are presented below.

- 15.14% of participants listed English as a second language
- 32.81% of participants possess a high school diploma.
- 21.45% of participants have completed an apprenticeship in a trade.
- 28.39% of participants possess a trade paper or ticket.
- 20.19% of the participants possess a degree or diploma from post-secondary educational institutions.
- 85.80% of participants had general mathematics instruction at some level.
- 82.33% of participants had general science instruction at some level.
- 84.86% of participants rated computer skills as the skill area they would most like to take courses in.
- 6.94% of participants have taken courses through their Union or Labor Relations Association.
- 48.26% of participants have taken courses through their employers.
- 40.38% of participants have taken courses on their own time.

BASIC SKILLS ASSESSMENT

The Basic Skills Assessment examined skill levels in four areas: reading, mathematics, writing, and self-expression. The detailed method and results are presented in a separate report. However, the main points are given here.

Results for the Basic Skills Assessment are presented in terms of three skill levels, as follows:

> **Independent level:** Questions answered with almost total [90% to 100%] accuracy indicate good comprehension at an independent or free skill level.
>
> **Instructional level:** Questions answered with 70% to 90% accuracy indicate a lack of complete comprehension, and this may be a level at which instruction is needed.
>
> **Frustration level:** Questions answered with below 70% accuracy indicate that comprehension is not adequate, and this may be a frustration level of skill usage.

Note: Since participation in the Basic Skills Assessment is voluntary, the results do not necessarily indicate the skill levels of the entire workforce.

Results

Reading Skills

- Independent level readers represent the highest proportion of participants in the technical and professional work areas.
- Instructional level readers represent the highest proportion of participants across the workforce.
- Frustration level readers represent the highest proportion of participants in the mill and refinery work areas.

Math Skills

- Independent levels represent the highest proportion of participants in the maintenance, administration, technical and professional work areas.
- Instructional levels represent the highest proportion of skill levels across the entire workforce.
- Frustration levels represent the highest proportion of participants in the mines, mill and refinery work areas.
- Computation involving decimals and fractions provided participants with the most difficulty.

BASIC SKILLS ASSESSMENT [cont.]

Writing Skills

- Independent writing levels represent the highest proportion of participants in the administration work areas.
- Instructional writing levels represent the highest proportion of participants in the maintenance work areas.
- Frustration writing levels represent the highest proportion of participants in the mines, mill, smelter, refinery, technical and professional work areas.
- The handwriting skills of the workforce in all work areas (with the exception of administration) are poor, and this leads to difficulties for those attempting to read the handwriting.
- The higher level of the administration work area writing skills is due in part to the nature of much of the work done by this department, which is mainly text-based information processing.
- The low levels of writing skills in the operational work areas correspond in part to the nature of the work conducted within these areas, little of which is text-based.
- Writing skills have only recently taken on increased importance within all levels of the workforce, and were not considered a required skill when much of the current workforce entered the industry.

Self-Expression Skills

- Independent levels represent the highest proportion of skill levels in the professional and refinery work areas.
- Instructional levels represent the highest proportion of skill levels in the technical work areas.
- Frustration levels represent the highest proportion of participants across the entire workforce.
- Frustration levels represent the highest proportion of skill levels in the mines, mill, smelter, maintenance and administration work areas.
- The poor overall levels obtained in the writing and self-expression portion of the assessment procedure indicate a serious impediment to the workforce's ability to communicate effectively with each other within individual work areas and between work areas.

WORKPLACE MATERIALS READABILITY ASSESSMENT

The vast array of reading materials found throughout the job site ranged from signs and symbols to highly technical reports. With the implementation of TQM, reporting procedures have increased the paper flow at all levels of the workplace.

Data Collection

Fifteen examples of General Reading Materials [materials all workers could be expected to read] were collected throughout the plant site. Five examples of work area specific reading materials were collected from each of the eight designated work areas within the plant site. A total of 55 documents totaling 734 pages of text were collected for analysis.

Data Analysis

The document samples were entered into a database using Word 6.0 [Microsoft 1994] and were then analyzed for readability using the grammar checking utility of the program. The measures used in this readability assessment are: percentage of passive sentences, Flesch Reading Ease Index, Flesch Grade Level Index, Flesch-Kincaid Index, and Gunning Fog Index.

Percentage of Passive Sentences

Writing experts commonly advise writers to avoid passive sentences unless the person or thing performing the action is unimportant or unknown.

Flesch Reading Ease and Flesch Grade Level

The Flesch Reading Ease and Flesch Grade Level indexes are based on the average number of words per sentence and the average number of syllables per 100 words. Standard writing averages approximately 17 words per sentence and 147 syllables per 100 words. The range for standard writing is indicated by a Flesch Reading Ease score of 60 — 70, or a Flesch Grade Level of 7 — 8. A lower Flesch Reading Ease score or a higher Flesch Grade Level indicates more difficult material.

Flesch-Kincaid

The Flesch-Kincaid index also assigns a grade level. A Flesch-Kincaid index of 7 or 8 is roughly equivalent to a Flesch Reading Ease Score of 60 to 70 [the range for standard writing]. A higher score indicates more difficult material.

Gunning Fog Index

This index is based on sentence length and the number of words per sentence with more than one syllable. Sentences with many multisyllable words are rated difficult to read. A higher score indicates more difficult material.

GENERAL READING MATERIALS ASSESSMENT RESULTS

Measure of Readability									
Document (General)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
INCO Newsletter	2.1	16.1	4.4	23%	67.4	8.3	7.9	10.9	Standard
P.I. Team Report	4.3	16	4.7	46%	61.7	8.8	8.6	8.5	Standard
Workplace Safety & Health Act	0.7	26.7	5.5	55%	45.7	13.6	12.2	14.6	Difficult
Explanation of Earnings	1	11.7	5.1	14%	52.2	12.3	8.8	10.7	Difficult
MSDS	0.8	21.9	4.8	27%	48	13	10.7	13.4	Difficult
Company Regulations	4	20	4.9	62%	45.4	13.7	11.9	13.8	Difficult
Deming Principals	1	22.4	5.2	28%	40.3	14.5	12.3	15.2	Difficult
Project Inf. Article	1.3	20.6	5.1	30%	39.5	14.6	12.7	13.8	Difficult
Union Newsletter	4.3	15.8	4.8	46%	61	8.9	8.7	8.7	Fairly Difficult
Safety Standards	1.8	22.9	4.3	72%	65.5	8.5	9.3	12.8	Fairly Difficult
Clipper	1.8	20.3	5.4	16%	25.5	17	14.7	16.7	Very Difficult
General Agreement	1.8	20.3	5.4	16%	25.6	17	14.7	16.7	Very Difficult
Benefits	0.4	23.4	5.8	0%	22.9	17	12.7	15.6	Very Difficult
WHMIS	2.8	21.1	5.1	45%	36.8	15	13.3	16.7	Very Difficult
Enviro/Health/Safety Report	0.9	25	5.4	66%	35.5	15.2	14.3	16.8	Very Difficult

WORK AREA READING MATERIALS ASSESSMENT RESULTS

Measure of Readability									
Document (Mines)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Mine Safety Report	4.3	14.2	4.8	0%	57.4	10.8	8.8	11	Fairly Difficult
Mines Evacuation Procedures	1.5	27	4.8	25	41.3	14.3	13.6	16.4	Difficult
Operations Check List	1.3	27.4	4.6	80%	49.6	13.1	13	17	Difficult
Mines Regulations	0.5	46	4.9	71	34.2	15.4	16.9	19.4	Very Difficult

Measure of Readability									
Document (Mill)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Incident Report	2	13.4	3.8	37%	86.5	6.3	4.5	6.1	Fairly Easy
Mill Memo	2.4	19.5	4	25%	71.3	7.9	7.5	9.9	Fairly Easy
OEMP Report	1.7	14.4	5.1	60%	59.4	10.2	8.2	9.7	Fairly Difficult
Mill Evac Procedure	1.7	23	4.7	26%	44.8	13.8	12.4	14.9	Difficult
Operating Procedure	1.7	22.4	4.7	33%	44.8	13.8	12.1	14.5	Very Difficult

Measure of Readability									
Document (Smelter)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Incident Report	1.3	13.1	4	37%	85.3	6.5	4.6	5.9	Easy
Operating Instructions	0.6	18.8	4.8	33%.	60	9	8.4	8.5	Standard
Breathing Apparatus Instructions	1.8	25.1	4.9	42%	45.8	13.6	13	15.2	Difficult
Safety/Health Committee report	1.6	22.2	5.5	18%	34.6	15.3	12.5	15	Difficult
Procedural Instructions	0.8	22.8	4.9	18	50.4	12.9	10.3	13.4	Difficult

WORK AREA READING MATERIALS ASSESSMENT RESULTS [cont.]

Measure of Readability									
Document (Refinery)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Procedural Instructions	5	19.1	4.7	73%	62.8	8.7	9.2	11.5	Standard
Operating Instructions	1.7	18.9	4.6	42%	65.4	8.5	8.7	10.5	Standard
Electro purification manual	1.4	19.1	4.8	66%	57.4	10.8	10	12.3	Fairly Difficult
Machine Instructions	2.6	20.5	4.8	61%	50.4	12.9	11.3	14.4	Difficult

Measure of Readability									
Document (Maintenance)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Hand Tool Instructions	3.5	16.1	3.8	35%	90.9	5.9	4.6	7.5	Very Easy
Maintenance Check List	1	8.7	5.1	0%	70.3	8	5.6	8.3	Fairly Easy
Work Order Procedures	0.9	15.4	4.9	11%	61.7	8.8	8	10.3	Standard
P.I. Team Report	2	19	4.3	60%	70.2	8	8	9.9	Standard
Report Instructions	4.7	9.1	5.1	14%	60.6	8.9	6.9	9.5	Fairly Difficult

Measure of Readability									
Document (Administration)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Legal Text	0.5	126	4.3	100%	72.3	7.8	8.1	12	Fairly Easy
Operating instructions	1.3	14.3	4.9	50%	64.7	8.5	7.6	9.1	Standard
Accounting Procedures	4.0	19.7	4.7	50%	56.9	10.9	9.8	12.9	Fairly Difficult
Accusation Procedures	7.0	18.0	4.8	42%	49.6	13.1	9.8	11.6	Difficult
Word Processing Text	1.0	21.0	5.1	0%	44.3	13.9	11.9	14.6	Difficult

WORK AREA READING MATERIALS ASSESSMENT RESULTS [cont.]

Measure of Readability									
Document (Technical)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Equipment Instructions	2.2	16.4	5.1	15%	47	13.4	10.6	13.3	Difficult
Report on Operations Status	3	23	4.8	55%	47.1	13.4	12.3	14.6	Difficult
Process Background	0.7	21.4	5.4	27%	29.7	17	13.9	13.3	Very Difficult
MSDS Hazcom Program	1.2	24.7	5.4	28%	27	17	15.3	18.1	Very Difficult
Survey Instructions [Underground]	2.3	25.9	4.9	33%	32.8	15.6	15.1	16.2	Very Difficult

Measure of Readability									
Document (Professional)	**Sentences per paragraph**	**Words per sentence**	**Characters per word**	**% Passive Sentences**	**Flesch Reading Ease Index**	**Flesch Grade Level Index**	**Flesch-Kincaid Index**	**Gunning Fog Index**	**Level of Writing**
Experimental Data	1.2	20.6	4.7	0%	53	15.9	15.9	20.9	Fairly Difficult
Basic Skills Study Memo	1.8	21.2	4.7	33%	49.8	13	11.6	15.2	Difficult
Chemical Report	4.3	25.5	4.9	46%	35.1	15.2	14.7	19.1	Very Difficult
Geological Report	2.2	27.4	5.6	36%	18.9	17	16.7	19.9	Very Difficult
Research Article	1.3	39.6	5.1	0%	30.5	15.9	15.9	20.9	Very Difficult

CONCLUSIONS

- Workplace reading skills are rated important as by the hourly workforce, paralleling the skills rated critical to the salaried workforce. This indicates the growing importance of these skills to the hourly workforce. (See page 5 for definitions of critical, essential, and important skills.)
- Basic mathematics are rated as critical, essential or important by the majority of participants.
- Technical mathematics are rated as critical, essential or important by the salaried workforce, and they are important for much of the hourly workforce.
- Measurement skills and the development of precision, accuracy and an understanding of tolerances are rated as critical by the majority of participants.
- Hand tool skills are rated as critical by the majority of participants.
- Writing skills are rated as critical, essential or important by the majority of participants.
- Instructional communications skills are rated as critical by the majority of participants.
- Information processing skills are rated as critical, essential or important by the majority of participants.
- Judgment and decision making skills are rated as critical by the majority of participants.
- Problem solving skills are rated as critical by the majority of participants.
- Formal reasoning, critical thinking, and logic skills are rated as critical by the majority of participants.
- The majority of reading materials examined are beyond the reading comprehension levels of the majority of participants when compared to the results of the basic skills assessment.
- The readability of documents increases with the level of responsibility within the industry.
- Government documents and employment documents are overly complicated in language, structure and presentation format.
- Materials with lower grade levels are, in general, written in a form that results in high Flesch Reading Ease rates, thus lowering their readability.

CONCLUSIONS [cont.]

- ***There is a strong interest and willingness on the part of employees to improve their Basic Skill Levels.***
- The perception of the value of improving Basic Skill Levels decreases with age of the respondent and the length of time in the industry.
- The increased demands on employees' basic workplace skills impact most on those employees who are moving from work area to work area, and on workers who have recently gained supervisory positions.
- Current training department courses and personnel are not geared to identify, evaluate or provide instruction in the areas of basic workplace skills development.
- Current employee induction and orientation procedures tend to mask or ignore problems which could arise on the work site due to a lack of basic workplace skills.
- ***The largest barrier to worker participation in upgrading programs is the schedule created by the shift work inherent in the industry.*** This was indicated by comments volunteered by several participants during their interviews.

RECOMMENDATIONS

General Recommendations

- That a distinction be made between the teaching of basic skills and the task-specific training current in the industry.
- That the existing employer/employee relationships be broadened to encourage a learning continuum for all.
- That a database of available community resources be compiled and made available to the workforce.
- That existing community resources allow for the inclusion and success of shift workers.
- That the inclusion and success of shift workers be a priority in the development and delivery of all programs.
- That the inclusion of an English as a Second Language component be a priority in program development.

Curriculum Development

- That industry-specific generic courses be developed to address the skills needs of the frustration level workforce.
- That a teaching philosophy be implemented in the development and presentation of all courses designed to address the skills gap evident in the study.
- That all curriculum development be constructed using a lifelong learning approach to basic skills development.
- That work area contextual instructional courses be developed to address the needs of the instructional level workforce.
- That formal ties be established with Provincial Community Colleges and Universities to develop methods to provide the independent level workforce with avenues for continued skills development.
- That an educational technology specialist be employed or contracted to develop a short- and long-term industry-specific Basic Skills Curriculum and delivery strategy.
- That all curriculum developments be designed to be implemented in the workplace and allow for the integration of the shift schedules.
- That all courses use materials with the following characteristics: they are clearly relevant to the workplace or to employment issues, the industry has them on hand or can easily obtain them, and they deal with subjects the employees care about. An example is material that deals with employee benefits.

RECOMMENDATIONS [cont.]

Program Delivery

- Computer-assisted learning offers an approach to basic skills development and upgrading that can provide generic introductory material as well as be adapted to provide contextual instruction. Adult learners often prefer the privacy and student-controlled pace of these learning systems.
- Since basic computer skills were requested as a priority course by the survey participants, it is likely that if an introductory computer skills tutorial is used as an introduction to other skill topics, a degree of participant motivation would be built into the basic skills curriculum.
- The graphical nature of the Windows 3.1 operating system for IBM-based systems is extremely useful as a presentation medium and, with the development of multi-media CD ROM systems, sound and video can be incorporated into tutorials to provide a degree of familiarity while providing learners with a dramatic, interesting learning package.
- Computer-assisted learning systems can be programmed to quiz learners at critical intervals in course content, can record results, and can provide easy access to the data to allow the learners to visually track their own progress. If learning systems are integrated into mainframe and desktop networks already in the workplace, the curriculum could be accessible to a multitude of learners at a variety of times and locations.

Course Development

In addition to introductory courses in basic skills and industry-specific generic courses that would benefit all employees, work-area contextual courses should be developed with attention given to the following skills areas:

- Technical terminology
- Drawing and sketching
- Charts, tables and graphs
- Form development
- Filling in forms
- Employment materials: collective agreement, benefits and deductions
- Basic mathematics
- Specifications
- Estimating
- Imperial and metric measurements
- Gauges, dials and readouts
- Calculators
- Giving and receiving directions and instructions
- Introduction to computers
- Using communication technologies
- Basic information processing systems
- Decision making
- Systems analysis
- Assessment strategies
- Evaluation methodologies

APPENDIX 1 - BASIC SKILLS SURVEY INSTRUMENT

BASIC EDUCATION IN THE WORKPLACEORGANIZATIONAL NEEDS ASSESSMENT
MANITOBA MINING SECTOR
PART A - BACKGROUND INFORMATION

1. Gender Male ☐ Female ☐
2. Age 16-24 ☐; 25-33 ☐; 34-42 ☐; 43-50 ☐; 50+ ☐
3. First Language English ☐ French ☐ Other ☐
4. Do you read English ☐ French ☐ Other ☐
5. Do you write English ☐ French ☐ Other ☐
6. Do you speak any other language in your home ☐

7. What is the main area of the mining industry you work in?

Underground	☐	Refinery	☐	Technical	☐
Mill	☐	Maintenance	☐	Professional	☐
Smelter	☐	Administration	☐		☐

8. What is your job title?
9. How long have you held this position? 1-2 ☐ 3-5☐ 6-10☐ 10-15☐ 20+☐
10. What was your previous job?
11. How long did you have that position?
12. How long have you worked in the mining industry? 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 20☐+
13. Occupation before entering the mining industry?

PART B EDUCATION

1. Where did you go to school?

WINNIPEG ☐	BRANDON ☐	THOMPSON ☐	OTHER ☐	WHERE:

2. What is the highest level of schooling you have completed?

less than grade 8	☐	grade 12	☐	complete 2 year certificate or diploma	☐
grade 8	☐	high school diploma	☐	complete 4 year degree [bachelors]	☐
grade 9	☐	Pre-apprenticeship	☐	more than 4 years of university	☐
grade 10	☐	Apprenticeship	☐	other	☐
grade 11	☐	Trade upgrading	☐		☐

3. If you hold a University degree, a diploma, or certificate which one?

4. Including high school and beyond, which courses have you completed in the following subject areas?

General Math	☐	Drafting / Print Reading	☐	Co-op Work Experience	☐
Algebra	☐	Metalworking	☐	Business	☐
Geometry	☐	Electricity	☐	Typing	☐
Trigonometry	☐	Electronics	☐	Computers	☐
Calculus	☐	Power[hydraulics/pneumatics]	☐	Writing Skills	☐
Statistics	☐	Cad / Cam	☐	Personal Communications	☐
General Science	☐	Shop Math	☐	English as a second language	☐
Chemistry	☐	Technical Writing	☐	Reading Improvement	☐
Physics	☐	Problem Solving	☐	Other	☐
Technology	☐	Pre Apprenticeship	☐		☐

5. Which courses would you like to take or review again if you had the chance based on your work experience?

Algebra	☐	Chemistry	☐	Computer Data Management	☐
General Math	☐	Physics	☐	Computer Numerical Control	☐
Geometry	☐	Drafting / Print Reading	☐	Computer Programming	☐
Shop Math	☐	Technical Writing	☐	Problem Solving	☐
Trigonometry	☐	Metalworking	☐	Study Skills	☐
Calculus	☐	Electricity	☐	Communications	☐
Statistics	☐	Electronics	☐	Basic Writing, Spelling, Reading	☐
General Science	☐	Power[auto/hydraulics/pneumatics]	☐	Others:	☐

6. Have you taken any courses offered by the Union / Labor Relations Association? Yes ☐ No ☐ What kind?
7. Have you received any training offered by an employer? Yes ☐ No ☐ What kind?
8. Have you taken any course on your own, night school, community college, etc.? Yes ☐ No ☐ What kind?
9. Do you have any trade papers or tickets? Yes ☐ No ☐ What kind?
10. Would you like to take a course to upgrade your basic

READING SKILLS ..... ☐	WRITING SKILLS .... ☐	MATH SKILLS .... ☐	SPEAKING SKILLS ☐

11. What specific types of courses would benefit you in your present position, or in regard to positions you aspire to?

BEST COPY AVAILABLE

PART C BASIC JOB SITE SKILLS

I. READING SKILLS

1. JOB SITE

Do you read?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Drawings / Sketches						
Permits						
Production / Work Schedules						
Specifications						
Computer Screen						
Computer Printouts						
Charts, Tables or Graphs						
Check Lists						
Memos or Notes						
Operating Instructions						
Time / Log Sheets						
Tool or Equipment Instructions						
Manuals						
Company Rules / Regulations						
Hazard Labels / WHIMIS / MSDS						
Safety Regulations						
Safety Signs / Posters						
Symbols						
Technical Journals						
Process Improvement Team Minutes						
Technical Literature						
Assay Sheets						
Incident / Inspection Reports						

2. COMPANY / UNION MATERIAL

Do you read ?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Collective Agreement						
Safety & Health Minutes						
Pension Information						
Constitution & Bylaws [Union]						
Training Material						
Mines Act						
Workplace Safety & Health Act						
Shareholders Report						
Benefits Statement						
Budgets / Costs						
Monthly reports from Other Areas						
Background on Other Areas						
Annual Report						
OHMP Report & Information						
Steel Gauntlet						
Extra						
Clipper						

3. Please list any other kinds of reading you do on the job.

4. Are you comfortable with what you read on the job? Yes ☐ No ☐ Sometimes ☐

5. What reading materials in your opinion should \ could be made clearer?

6. PERSONAL READING SKILLS

Do you read?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Newspapers	☐	☐	☐	☐	☐	☐
Magazines	☐	☐	☐	☐	☐	☐
Professional Journals	☐	☐	☐	☐	☐	☐
Light books [novels, self help, how to]	☐	☐	☐	☐	☐	☐
Non fiction titles	☐	☐	☐	☐	☐	☐
Textbooks	☐	☐	☐	☐	☐	☐
Religious materials	☐	☐	☐	☐	☐	☐
Children's school materials	☐	☐	☐	☐	☐	☐
comic books	☐	☐	☐	☐	☐	☐

9. As a reader, do you consider yourself to be:

Poor ☐	Below Average ☐	Average ☐	Above Average ☐	Excellent ☐

BEST COPY AVAILABLE

II: MATHEMATICS SKILLS

1: BASIC MATH:

On the job do you?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Add or Subtract Numbers	☐	☐	☐	☐	☐	☐
Add or Subtract Fractions	☐	☐	☐	☐	☐	☐
Add or Subtract Decimals	☐	☐	☐	☐	☐	☐
Multiply or Divide Numbers	☐	☐	☐	☐	☐	☐
Multiply or Divide Fractions	☐	☐	☐	☐	☐	☐
Multiply or Divide Decimals	☐	☐	☐	☐	☐	☐
Convert Fractions & Decimals	☐	☐	☐	☐	☐	☐
Count How Many	☐	☐	☐	☐	☐	☐
Estimate Time	☐	☐	☐	☐	☐	☐
Estimate Materials	☐	☐	☐	☐	☐	☐

2: TECHNICAL MATH:

On the job do you use?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Percentage [%]	☐	☐	☐	☐	☐	☐
Ratios or Proportions	☐	☐	☐	☐	☐	☐
Data	☐	☐	☐	☐	☐	☐
Graphs, Charts, Tables	☐	☐	☐	☐	☐	☐
Statistics	☐	☐	☐	☐	☐	☐
Probabilities	☐	☐	☐	☐	☐	☐
Trigonometric Functions	☐	☐	☐	☐	☐	☐
Right Triangle Relationships	☐	☐	☐	☐	☐	☐
Applied Linear Equations	☐	☐	☐	☐	☐	☐
Applied Non Linear Equations	☐	☐	☐	☐	☐	☐
Uses of Powers and Roots	☐	☐	☐	☐	☐	☐
Scientific Notations	☐	☐	☐	☐	☐	☐
Signed Numbers and Vectors	☐	☐	☐	☐	☐	☐
Scale Drawings	☐	☐	☐	☐	☐	☐
Lines and Angles	☐	☐	☐	☐	☐	☐
2 Dimensional Shapes	☐	☐	☐	☐	☐	☐
3 Dimensional Shapes	☐	☐	☐	☐	☐	☐
Estimating Solutions	☐	☐	☐	☐	☐	☐
Problem Solving	☐	☐	☐	☐	☐	☐
Specifications	☐	☐	☐	☐	☐	☐
Calculate Weighted-over readings [%]	☐	☐	☐	☐	☐	☐
Use Concentration Data [p.p.m., g.p.l., etc.]	☐	☐	☐	☐	☐	☐

3: MEASUREMENT SKILLS:

Do you work with?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Measure in Imperial	☐	☐	☐	☐	☐	☐
Measure in Metric	☐	☐	☐	☐	☐	☐
Convert Imperial & Metric Measures	☐	☐	☐	☐	☐	☐
Measure Volume	☐	☐	☐	☐	☐	☐
Precision, Accuracy, Tolerance	☐	☐	☐	☐	☐	☐
Temperature	☐	☐	☐	☐	☐	☐
Pressure	☐	☐	☐	☐	☐	☐
Volume	☐	☐	☐	☐	☐	☐
Flow	☐	☐	☐	☐	☐	☐
Mass\Weight	☐	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐	☐
Density	☐	☐	☐	☐	☐	☐
pH	☐	☐	☐	☐	☐	☐
Measure Current / Voltage	☐	☐	☐	☐	☐	☐
Millivolts	☐	☐	☐	☐	☐	☐

4: TOOL SKILLS

For your job do you use?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Hand Tools	☐	☐	☐	☐	☐	☐
Tape Measure	☐	☐	☐	☐	☐	☐
Scales on Equipment	☐	☐	☐	☐	☐	☐
Gauges or Dials on Equipment	☐	☐	☐	☐	☐	☐
Mobile Equipment	☐	☐	☐	☐	☐	☐
Calculator	☐	☐	☐	☐	☐	☐
Computer	☐	☐	☐	☐	☐	☐
Advanced Instruments / Instrumentation	☐	☐	☐	☐	☐	☐

5: Please list any other kinds of mathematics you use on the job.

6: Are you comfortable with the kinds of math your job requires Yes ☐ No ☐

7: PERSONAL MATHEMATICS SKILLS

Do you ?	No	Yes	Sometimes
Handle the household finances	☐	☐	☐
Check your own bank statements	☐	☐	☐
File your own tax returns	☐	☐	☐
Help your children with math homework	☐	☐	☐
Calculate sales tax [PST, GST]	☐	☐	☐

BEST COPY AVAILABLE

III: COMMUNICATION SKILLS

1: WRITING SKILLS

On the job do you?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Fill in Forms	☐	☐	☐	☐	☐	☐
Fill in Time Cards	☐	☐	☐	☐	☐	☐
Keep Track of Hours	☐	☐	☐	☐	☐	☐
Write Shift Reports	☐	☐	☐	☐	☐	☐
Leave Notes / Memos	☐	☐	☐	☐	☐	☐
Write Work Orders	☐	☐	☐	☐	☐	☐
Write Incident Reports	☐	☐	☐	☐	☐	☐
Write Instructions	☐	☐	☐	☐	☐	☐
Make Drawing / Sketches	☐	☐	☐	☐	☐	☐
Write Letters / Reports	☐	☐	☐	☐	☐	☐
Write Safety Reports	☐	☐	☐	☐	☐	☐
Input Data on Computer	☐	☐	☐	☐	☐	☐

2: ORAL SKILLS

On the job do you?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Follow Verbal Directions	☐	☐	☐	☐	☐	☐
Give Verbal Directions	☐	☐	☐	☐	☐	☐
Follow Written Directions	☐	☐	☐	☐	☐	☐
Give Written Directions	☐	☐	☐	☐	☐	☐
Ask Questions	☐	☐	☐	☐	☐	☐
Take Messages	☐	☐	☐	☐	☐	☐
Speak in Large Groups	☐	☐	☐	☐	☐	☐
Speak in Small Groups	☐	☐	☐	☐	☐	☐
Speak with Outside People [eg. suppliers]	☐	☐	☐	☐	☐	☐
Participate in Meetings	☐	☐	☐	☐	☐	☐
Use the Telephone	☐	☐	☐	☐	☐	☐

3: COMMUNICATION TOOL USE SKILLS

On the job do you?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Use the Typewriter	☐	☐	☐	☐	☐	☐
Use the Fax Machine	☐	☐	☐	☐	☐	☐
Use the Photocopier	☐	☐	☐	☐	☐	☐
Use Hand Signals	☐	☐	☐	☐	☐	☐
Use 2 Way Radio	☐	☐	☐	☐	☐	☐
Use MD ISSUE	☐	☐	☐	☐	☐	☐
Use Mainframe Computer	☐	☐	☐	☐	☐	☐
Use Process Control Computer	☐	☐	☐	☐	☐	☐
Use a Personal Desktop Computer	☐	☐	☐	☐	☐	☐
Use a Portable Computer	☐	☐	☐	☐	☐	☐
Use Remote Control Radio Equipment	☐	☐	☐	☐	☐	☐
Coordinate Work With Other Groups	☐	☐	☐	☐	☐	☐
Work with Trade Groups	☐	☐	☐	☐	☐	☐

4: SOCIAL SKILLS

On the job do you	No	Yes	Daily	Weekly	Monthly	1/2 Year
Work by yourself	☐	☐	☐	☐	☐	☐
Work with a partner or helper	☐	☐	☐	☐	☐	☐
Work as a member of a team	☐	☐	☐	☐	☐	☐

5: Please list any other kinds of communications skills you use on the job.

6: PERSONAL COMMUNICATION SKILLS

Are you ?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Involved in community groups	☐	☐	☐	☐	☐	☐
Involved in PTA	☐	☐	☐	☐	☐	☐
Involved in church groups	☐	☐	☐	☐	☐	☐
Involved in recreational groups	☐	☐	☐	☐	☐	☐
Involved in children's groups	☐	☐	☐	☐	☐	☐
Others	☐	☐	☐	☐	☐	☐

BEST COPY AVAILABLE

IV: PRODUCTIVE THINKING SKILLS

1: INFORMATION PROCESSING SKILLS:

On the job do you:	No	Yes	Daily	Weekly	Monthly	1/2 Year
Process information in a variety of ways	☐	☐	☐	☐	☐	☐
Research information or data	☐	☐	☐	☐	☐	☐
Analyze information or data	☐	☐	☐	☐	☐	☐
Design systems	☐	☐	☐	☐	☐	☐
Design products	☐	☐	☐	☐	☐	☐
Engineer solutions	☐	☐	☐	☐	☐	☐
Perform system analysis [troubleshooting]	☐	☐	☐	☐	☐	☐
Perform technological assessments	☐	☐	☐	☐	☐	☐
Identify inconsistencies, deficiencies, and contradictions	☐	☐	☐	☐	☐	☐
Make inferences	☐	☐	☐	☐	☐	☐
Identify main ideas	☐	☐	☐	☐	☐	☐
Summarize and condense information, facts	☐	☐	☐	☐	☐	☐
Note similarities and differences between facts	☐	☐	☐	☐	☐	☐
Classify facts	☐	☐	☐	☐	☐	☐
Identify stated and unstated reasons	☐	☐	☐	☐	☐	☐
Recognize associations and connect information	☐	☐	☐	☐	☐	☐
Form conclusions and generalizations from facts	☐	☐	☐	☐	☐	☐
Make predictions on the basis of patterns in data	☐	☐	☐	☐	☐	☐
Evaluate information according to set criteria	☐	☐	☐	☐	☐	☐
Make decisions based on information supplied by others	☐	☐	☐	☐	☐	☐

2: JUDGMENT AND DECISION MAKING SKILLS:

On the job are you required to	No	Yes	Daily	Weekly	Monthly	1/2 Year
Identify facts, opinions, and reasoned arguments	☐	☐	☐	☐	☐	☐
Recognize evidence and check it	☐	☐	☐	☐	☐	☐
Deal with differing value systems	☐	☐	☐	☐	☐	☐
Distinguish between valid and questionable assumptions	☐	☐	☐	☐	☐	☐
Spot inconsistencies and gaps in information	☐	☐	☐	☐	☐	☐
Gather and organize data	☐	☐	☐	☐	☐	☐
Decide whether statements contradict each other	☐	☐	☐	☐	☐	☐
Evaluate others' judgments	☐	☐	☐	☐	☐	☐

3: PROBLEM SOLVING SKILLS:

On the job are you required to	No	Yes	Daily	Weekly	Monthly	1/2 Year
Solve problems on your own	☐	☐	☐	☐	☐	☐
Solve problems as a member of a team	☐	☐	☐	☐	☐	☐
Identify general problems	☐	☐	☐	☐	☐	☐
Determine the attributes of a problem	☐	☐	☐	☐	☐	☐
Clarify the problem for others	☐	☐	☐	☐	☐	☐
Formulate questions about the problem	☐	☐	☐	☐	☐	☐
Formulate hypotheses for testing	☐	☐	☐	☐	☐	☐
Evaluate hypotheses	☐	☐	☐	☐	☐	☐
Figure out experiments to test hypotheses	☐	☐	☐	☐	☐	☐
Integrate information about the problem	☐	☐	☐	☐	☐	☐
Formulate solutions	☐	☐	☐	☐	☐	☐
Examine and rank solutions	☐	☐	☐	☐	☐	☐
Choose solutions as an individual	☐	☐	☐	☐	☐	☐
Choose solutions as a member of a team	☐	☐	☐	☐	☐	☐
Direct others in the application of the solution	☐	☐	☐	☐	☐	☐
Seek acceptance of solutions	☐	☐	☐	☐	☐	☐
Monitor solutions	☐	☐	☐	☐	☐	☐

4: FORMAL REASONING, CRITICAL THINKING, LOGIC SKILLS

On the job do you	No	Yes	Daily	Weekly	Monthly	1/2 Year
Determine the meaning of terms and statements	☐	☐	☐	☐	☐	☐
Notice qualities of things: how things differ or are alike	☐	☐	☐	☐	☐	☐
Notice successive stages in which things occur	☐	☐	☐	☐	☐	☐
Break down wholes into component parts	☐	☐	☐	☐	☐	☐
Identify and sort things into classes	☐	☐	☐	☐	☐	☐
Recognize analogies and reason by analogy	☐	☐	☐	☐	☐	☐
Represent ideas as three-dimensional images	☐	☐	☐	☐	☐	☐
Judge the credibility of sources	☐	☐	☐	☐	☐	☐
Detect bias, stereotypes	☐	☐	☐	☐	☐	☐
Distinguish relevant from irrelevant data	☐	☐	☐	☐	☐	☐
Distinguish fact from opinion	☐	☐	☐	☐	☐	☐
Connect causes and effects	☐	☐	☐	☐	☐	☐
Recognize that inductive reasoning is inferring from facts	☐	☐	☐	☐	☐	☐
Use scientific method as a process of validation	☐	☐	☐	☐	☐	☐
Use evidence to examine the validity of beliefs	☐	☐	☐	☐	☐	☐
Examine arguments for ambiguity in the line of reasoning and for contradictory statements	☐	☐	☐	☐	☐	☐
Judge whether a definition is adequate, an assumption is correct, and a conclusion is possible, valid or necessary	☐	☐	☐	☐	☐	☐
Use syllogistic reasoning	☐	☐	☐	☐	☐	☐
Analyze and evaluate arguments	☐	☐	☐	☐	☐	☐

BEST COPY AVAILABLE

5: CREATIVE THINKING SKILLS

On the job do you?	No	Yes	Daily	Weekly	Monthly	1/2 Year
Analyze open-ended situations and problems and sustain, reorganize, or break down the problem	☐	☐	☐	☐	☐	☐
List attributes of objects and situations	☐	☐	☐	☐	☐	☐
Generate ideas	☐	☐	☐	☐	☐	☐
Generate multiple ideas to support multiple viewpoints on the same issue	☐	☐	☐	☐	☐	☐
Identify and examine alternatives	☐	☐	☐	☐	☐	☐
Rank alternatives and choose the best	☐	☐	☐	☐	☐	☐
Use insight	☐	☐	☐	☐	☐	☐
Use intuition	☐	☐	☐	☐	☐	☐
Identify relationships between situations that may appear unconnected	☐	☐	☐	☐	☐	☐
Make unusual connections between facts	☐	☐	☐	☐	☐	☐
Tolerate ambiguity, hold conclusion off to search for innovative ideas	☐	☐	☐	☐	☐	☐
Elaborate details	☐	☐	☐	☐	☐	☐
Synthesize from various sources to form a new whole	☐	☐	☐	☐	☐	☐
Extrapolate from limited facts	☐	☐	☐	☐	☐	☐
Use imagery	☐	☐	☐	☐	☐	☐
Use metacognition	☐	☐	☐	☐	☐	☐
Use metadata	☐	☐	☐	☐	☐	☐

APPENDIX 2 - REFERENCES

Davis, Keith, and John Newstrom. *Human Behavior at Work: Organizational Behavior*. 7th. ed. New York: McGraw-Hill Inc., 1972

Cozby, Paul C. *Methods in Behavioral Research*. 4th ed. Mountain View: Mayfield Publishing Co., 1989.

Christenson, Larry. *Experimental Methodology*. 4th ed. Boston: Allyn and Bacon, Inc., 1988.

McCall, Robert B. *Fundamental Statistics for Behavioral Sciences*. 5th ed. Toronto: Harcourt Brace Jovanovich, 1990.

Mendenhall, William, James E. Reinmuth, and Robert Bever. Durban, Dale. *Statistics for Management and Economics*. Boston: Prindle, Weber & Schmidt, 1986.

Jones, Barry. *Sleeper, Wake: Technology & the Future of Work*. Melbourne: Oxford University Press, 1986.

Aylesworth, Thomas G. and Gerald M. Reagan. *Teaching for Thinking*. New York: Doubleday & Company, Inc., 1969.

Laine, Olin J. and Sue Geddis. *Investigating Literacy*. Toronto: Thompson Educational Publishing, Inc., 1992.

Chisman, Forrest P. and Associates. *Leadership for Literacy*. San Francisco: Jossey-Bass Publishers, 1990.

Epley, Thelm M. *Promoting Productive Thinking*. Ventura: The National/State Leadership Training Institute on the Gifted & Talented, 1988.

Steinbach, Robert. *The Adult Learner: Strategies for Success*. Menlo Park: Crisp Publications, Inc. 1993.